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Socio-Economic, Health and Ecological Sustainability of Vegetable Supplies in West African Cities: Assessment of Stakeholders' Knowledge, Attitudes and Practices in Accra and Greater Lomé

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Abstract

In West Africa, vegetable supply chain development projects in Accra and Greater Lomé focus scarcely on the knowledge, attitudes and practices (KAP) of vegetable producers, traders and processors. Thus, the research aims to assess the level of sanitary, socio-economic and environmental sustainability of vegetable production, trade and processing in these cities, based on the knowledge, attitudes and practices of stakeholders. A quantitative multi-criteria evaluation approach was adopted, with reference to Global Reporting Initiative (GRI) standard 13 and Codex Alimentarius (CXC 1-1969 then CXC 53-2003). A sample of 303 people (156 in Accra and 147 in Greater Lomé) was formed using purposive sampling based on the assertion of E.R. Babbie (2016) and L. Kish (1965) combined with the comparison of S. Sudman (1976). Kobocollect and MS Excel respectively served to collect data and calculate KAP scores and percentages. Arcgis and Google Earth facilitated geographic representation of the data. The results reveal low rates of ecological (27.2%), health (26.9%), socio-economic (39.9%), technological and innovative (18.6%) KAP, evaluated at 28.6%. These results are unfavorable to the achievement of the SDGs. Hence the importance of an integrated, ongoing eco-nutritional education program for all stakeholders.

Keywords: *Urban food supply, Eco-nutritional culture, Sustainability, Market garden vegetables, Accra and Greater Lomé.*

Introduction

Urban food supply is witnessing significant changes worldwide (B. Hérault and al., 2019; D.J. Hoffman and H. Posluszny, 2023; E. Nyangwile and al., 2022, p. 5-8; B.M. Popkin and al., 2020). These changes concern the misuse of pesticides, fertilizers, technological tools and biological modification practices in agri-food production, sales and processing (M.M. Billah and al., 2023; R. Calderon and al., 2022; M. Halder and al., 2022; B. Le Huy and al., 2022; G.N. Murthy and P.B.S. Yadav, 2024; H. Ping and al., 2022). These urban agrifood transformations are also associated with poor hygiene practices and protection of natural ecosystems in the supply of edible foodstuffs. The downside of these facts is the increase in prevalence rates of chronic food-borne health pathologies, pollution and degradation of the natural environment and their negative socio-economic effects, the first victims of which are the most vulnerable social strata (R.K. Bannor and al., 2022; P. Biswas and al., 2023; N.N. Botha and al., 2023; M. Khan and al., 2023; A. Raj and al., 2023; P. Rajak and al., 2023; M. Tudi and al., 2021). These "food systems realities" can be observed in cities in developed countries as well as in those whose states are classified as middle-income or low-income countries. In the latter two socio-economic classes, particularly in West Africa, urban agrifood systems are more affected by the above-mentioned mutations due to socio-economic and cultural globalization, urbanization and accelerated demographic growth linked to the development of new information and communication technologies (E.G. Anaduaka and al., 2023).

In this context, and in the general pattern of West African urban centers, apart from problems of access to land, quality fertilizers, sustainable irrigation, financing and adequate technological tools, market gardeners in Accra and Greater Lomé generally lack the technical mastery and equipment needed to produce vegetables in the quantity and quality required to satisfy urban demand (P. Burnod and al., 2022; C. de Steenhuijsen Piters and al., 2021; A. Diallo and al., 2020; H.E. Julien and al., 2021; M. Kanda and al., 2017; P.N. Matondo and al., 2023; S.K. Osei and al., 2017; J.A. Puppim de Oliveira and A. Ahmed, 2021; J. Quansah and al., 2020). In both towns, as in other urban agglomerations in West Africa, market gardeners

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also tend to neglect the protection of vegetables against contamination, and are unable to avoid losses during storage, preservation or transport (L. Peivasteh-roudsari and al., 2023; J.K. Quansah and al., 2018). For their part, vegetable traders and processors in this sub-region often experience challenges such as the socio-technical skills required to preserve, store, package, cook and present their food or dishes to their customers (K. Abass and al., 2019; S. Akhter and A. Cameron, 2023; N.N. Botha and al., 2023; L. Peivasteh-roudsari and al., 2023; K. Soncy and al., 2019). The difficulty of complying with hygiene rules, avoiding losses and properly managing the waste resulting from the handling of these foods in the capital cities of Ghana and Togo is potentially a significant cause of the transmission of several health pathologies. These pathologies can affect humans, animals, living microorganisms and plants alike (A. Ahamad and J. Kumar, 2023, p. 1-2; A.W. Arimiyaw and al., 2021; H. El Bilali and al., 2021; J.L. Gallego and J. Olivero-Verbel, 2021; C. Mizéhoun-Adissoda and al., 2022; V.M. Pathak and al., 2022). And these problems are often associated with air pollution, surface or underground water sources and soil pollution, which can in turn increase the risk of climatic variations (I. Ansari and al., 2021, p. 79-80, 84-85, 88-89).

However, the difficulties undermining the supply of vegetables in Accra and Greater Lomé, as in several other capital cities, and even in peri-urban and rural areas of the West African sub-region, have led to the development of a number of projects and programs aimed at making agri-food systems more sustainable. Recent examples include the West African Food System Resilience Program (PRSA/FSRP) and the West African Agroecology Program. As in other West African capital cities, the measures taken and implemented in the municipal territories of Accra and Greater Lomé to overcome the challenges of their vegetable supply chains are not identical, although they are broadly based on international, sub-regional and national food and nutrition security policies, programs and projects. On both sides, these differences are based, a priori, on the specificities of each city in terms of knowledge, representations and practices combined with the provision of vegetables to retail "consumers".

Indeed, Accra adopted a regulation for the implementation of Ghana's food safety and hygiene policy on April 19, 2017. This regulation concerns environmental protection, nutrition, hygiene and the general well-being of producers and consumers, but its application remains difficult (V. Linderhof and al., 2019, p. 2). Improving productivity and reducing food loss and waste are the basic elements of efforts to make food systems sustainable in Ghana's main urban agglomeration (AMA, 2020, p. 25). Through specific research, V. Linderhof and al. (2023, p. 29-30) have proposed an approach to what Accra's food system should look like in 2050, based on agrifood transition principles. This approach emphasizes food production, sales, processing and consumption practices based on endogenous knowledge and guaranteeing all social strata a minimum permanent access to healthy, sufficient and nutritious food (V. Linderhof and al., 2023, p. 24-29). An Accra Resilience Strategy was even launched by the city's Metropolitan Assembly on March 29, 2019.

In Greater Lomé, it's the Transition of Agricultural Systems and Food on Territories (TERSAA) program that is helping to make national food security and nutrition policies more concrete in urban areas. This program, which benefits the urban and semi-urban territories of Togo, Benin, Burkina Faso, Colombia and Peru, aims to make food systems viable on the territorial scales of these states, particularly at the post-productive stage. More specifically, the program aims to open up new market outlets for producers in the targeted territories, and to encourage the dissemination and perpetuation of sustainable supply practices by including all local community actors. The local consumer, in turn, gains access to quality, locally-produced food. TERSAA is fully in line with the National Program for Agricultural Investment and Food and Nutritional Security (PNIASAN) and the Togo Country Strategic Plan (2022-2026).

As with the national food system resilience programs of Ghana and Togo, scientific analyses of the vegetable value chains of the Accra Metropolitan Assembly (AMA) and the Greater Lomé Autonomous District (DAGL) have focused on strengthening vegetable productivity, availability and accessibility (K. Abass and al., 2019; A. Abu Hatab and al., 2019; F. Akabanda and al., 2017; M. Kanda and al., 2014) . The same applies to the socio-economic living conditions of producers and the challenges they face in using pesticides and fertilizers in market gardening (Y. Adjrah and al., 2013; H.E. Julien and al., 2021). These researches has also been interested in addressing issues of hygiene, health and environmental preservation related to vegetable production, marketing and processing in Accra and Greater Lomé (Y. Adjrah and al.,

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2013, p. 715-716; Y. Adjrah and al., 2011; L.K. Agboyi and al., 2015; K. Anani and al., 2013; R.A. Ayambire and al., 2019; A. Diallo and al., 2020; M. Kanda and al., 2012; M. Kanda and al., 2013; Y. Maehata and al., 2012; G. Owusu-Boateng and K.K. Amuzu, 2013).

In comparison to Greater Lomé, in Accra, the city's 2023 annual action plan only considers caterers in the food supply chain, without specifying the specific focus on market gardening (AMA, 2022, p. 7). Work to assess the effects of levels of knowledge, attitudes and practices in the food industry on food safety and hygiene in Accra also focused on processing uses, with less emphasis on the vegetable production and sales links. The most discussed topics were the determinants of food market choices and restaurant owners' cooking practices in terms of their knowledge, attitudes and practices on food safety, hygiene and health (F. Akabanda and al., 2017; M.I. Dzudzor and N. Gerber, 2023; A. George Amponsah and B. Ekua Anamoaba, 2011; O.A. Odeyemi and al., 2019). Socio-economic and environmental aspects have only been partially addressed.

In Togo's first urban conurbation, a number of social science studies have dealt with food, but have focused more on consumer behavior. Questions on food mutations and permanence, eating out, food fears, e-food, techno-social food innovations and food representations were essentially covered. (K.E. Assinou, 2020; K. Kpotchou, 2013, 2017, 2018a, 2018b, 2020, 2021).

This situation highlights the lack of scientific assessment of the agrifood knowledge, attitudes and practices of all the key actors in the Accra and Greater Lomé vegetable sectors. Even development strategies, programs and projects at the territorial level of these cities take a lesser interest in urban food planning with regard to vegetable supply. However, an eco-nutritional culture that includes all stakeholders in the targeted vegetable supply chains in a participatory way through communication to achieve sustainable behavioral changes can influence norms, values, perceptions, knowledge and beliefs related to food supply. It can also help change agri-food procurement choices, preferences and practices in the AMA and DAGL vegetable supply chains (S. Dury and al., 2019, p. 15,17). Under these conditions, attention needs to be paid to the level of eco-nutritional culture of actors in the vegetable supply chains of Accra and the capital of Togo with regard to their socio-economic, health, environmental, technological and inclusivity sustainability for the development of adequate urban agrifood sustainability policies.

These facts raise the following question: what are the levels of knowledge, perceptions and practices of vegetable producers, traders and processors in Accra and Greater Lomé with regard to the socio-economic, health and environmental well-being of their activities? The research is based on the hypothesis that market garden supply actors in Accra and Greater Lomé have low levels of knowledge and low rates of good practice in relation to the possible effects of their activities on socio-economic life, health and the preservation of the natural ecosystems that support them. The research aims to assess the level of health, socio-economic, environmental, technological and inclusive sustainability of vegetable production, marketing and processing in the first Agglomerations of Ghana and Togo.

In this statement, nutritional ecology is an interdisciplinary approach that studies the sustainability of food systems through their structures, interdependencies and dynamics in relation to their effects (the activities and practices of actors in food supply and value chains) in four dimensions: nutritional health, social life, economic situation and natural environment of the actors who interact internally or externally (C. Leitzmann, 2003; K. Schneider and I. Hoffmann, 2011, p. 1-2).

Materials and Methods

Physical Framework

The assessment of knowledge, attitudes and practices relating to the socio-economic, health and environmental sustainability of the market garden sectors in Accra and Greater Lomé has as its population base the Accra Metropolitan Assembly (AMA) and the Autonomous District of Greater Lomé (DAGL). Accra is the urban center of Ghana; it has an area of 139, 674 Km^2

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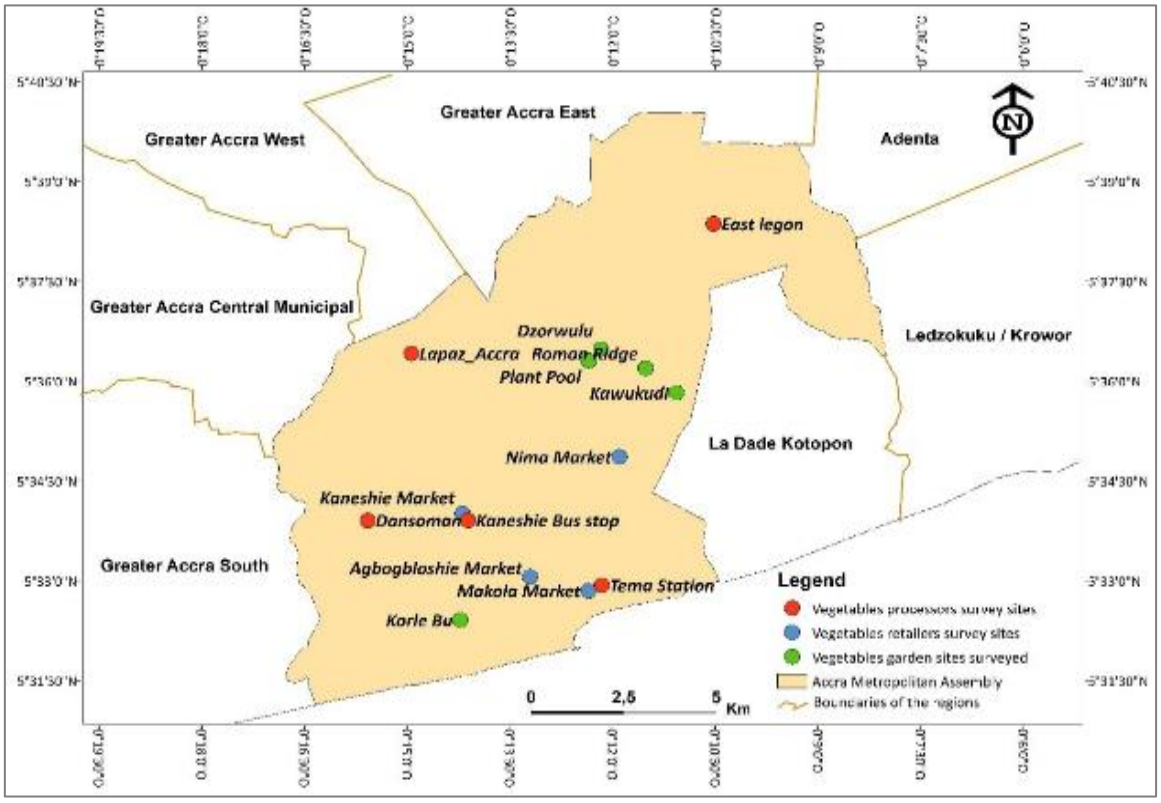
(GSS, 2014, p. 1) while Greater Lomé, under the same status, has 425.6 Km². Both cities concentrate the key administrative, political and economic functions of Ghana and Togo (R.A. Acheampong, 2021, p. 5; K.A. Biakouye, 2014, p. 69, 77-79; GSS, 2014, p. 3-4). The Accra Metropolitan Area (AMA) has at its northern boundary the "Ga West Municipal", to the west the "Ga South Municipal", to the south the Gulf of Guinea and to the east the "La Dadekotopon Municipal". The DAGL is bordered by the Zio prefecture to the north, Ghana to the west, the Lacs prefecture to the east and the Gulf of Guinea to the south. The AMA is made up of 12 districts, and Greater Lomé comprises thirteen communes in the Gulf and Agoè-Nyivé prefectures. Accra has a population of 1,281,570, including 662,158 women and 619,412 men (GSS, 2021, p. 80). Greater Lomé is home to 2,767,416 people: 1,060,554 men and 1,706,862 women (INSEED, 2022, p. 19, 22-30).

As a priority, the choice of these cities for research is linked to the differences and similarities in the influence of socio-cultural, economic, health, environmental, demographic, socio-political and regulatory factors on the production, sale and processing of vegetables in Accra and Greater Lomé. People's knowledge, representations and practices of vegetable supply, associated with socio-cultural values and norms that differ or are identical from one capital city to another, can be eroded over time, consolidated or partially or even completely transformed. The option of assessing the socio-economic, health and environmental sustainability of Accra and Greater Lomé in West Africa is also explained by the fact that all the countries in this African sub-region are classified as either lower-middle-income or low-income states. Accra is the capital of Ghana, a lower-middle-income country, and Greater Lomé is the largest urban agglomeration in Togo, a low-income country.

Geographical representations of data collection locations are shown below.

Map 1: Accra Date Collection Sites



Source : K. E. Assinou and K. Kpotchou, 2024

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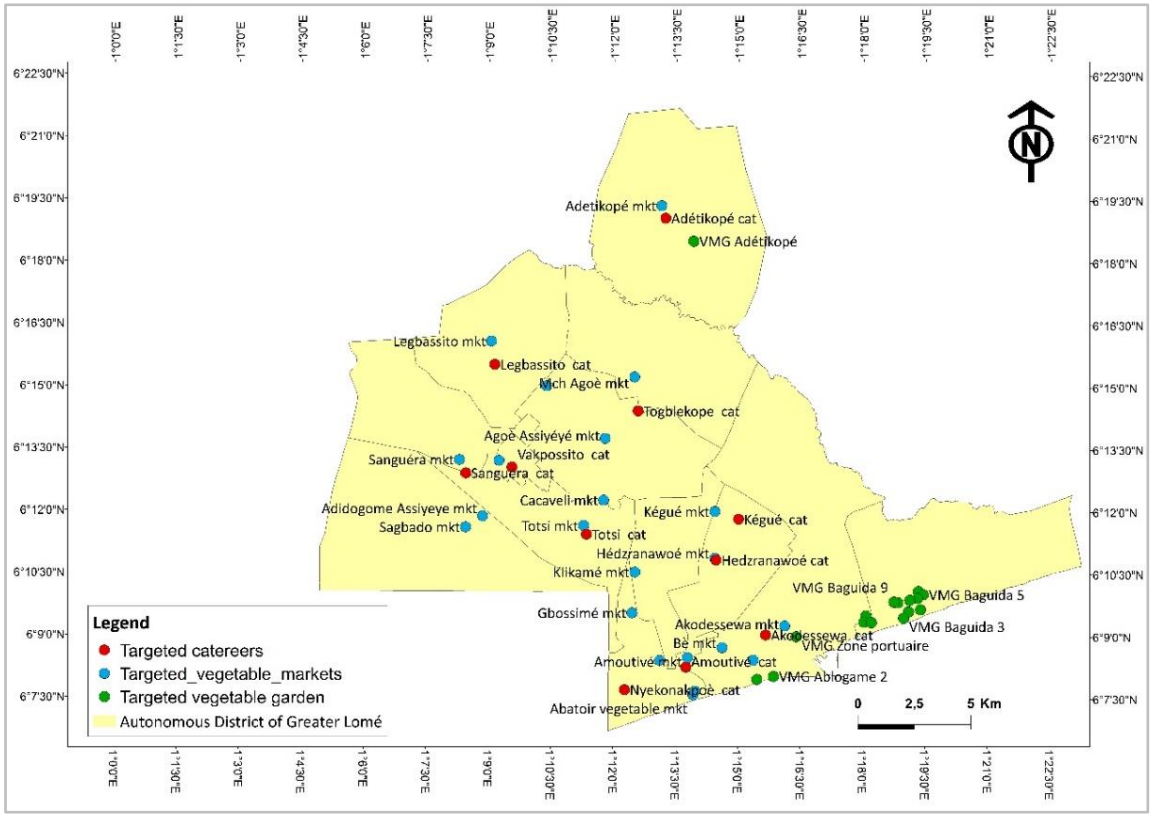
Map 2: Greater Lomé data collection sites



Source: K. E. Assinou and K. Kpotchou, 2024

Research Methods, Techniques, Tools and Indicators

This research is based on a multi-criteria approach in line with the multidimensional and transdisciplinary nature of agri-food chains (C.C. Esnouf and al., 2011, p. 179-180). The following standards and documents inspired the production of the questionnaires:

- the consolidated set of Global Reporting Initiative 2023 standards (GSSB, 2023) ;
- the farm sustainability Indicators methode (IDEA4) (F. Zahm and al., 2023) ;
- the document « The top 100 questions of importance to the future of global agriculture » (J. Pretty and al., 2010);
- le Codex Alimentarius :

"General principles of food hygiene" (CXC 1-1969)

"Code of hygienic practice for fresh fruit and vegetables" (CXC 53-2003);

“Code of practice for packaging and transport of fresh fruit and vegetables” (CXC 44-1995).

With regard to sustainability analysis, we consider the socio-economic, health, nutritional, ecological, educational, innovation and technological dimensions of sustainable food supply.

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The following indicators have been selected:

- producers', processors' and traders' levels of awareness of the socio-economic, environmental and health aspects influenced by their activities ($\bar{x}pct1_{(AMA\_DAGL)}$) ;
- stakeholders' levels of awareness of their social responsibility in their relations with their collaborators ($\bar{x}pct2_{(AMA\_DAGL)}$) ;
- trends in stakeholders' knowledge and best practices regarding health risks in the market garden industry ($\bar{x}pct3_{(AMA\_DAGL)}$) ;
- food protection and preservation at production, processing and marketing stages ($\bar{x}pct4_{(AMA\_DAGL)}$) ;
- risks of loss and waste ($\bar{x}pct5_{(AMA\_DAGL)}$) ;
- risks of Environmental Pollution and poor waste management ($\bar{x}pct6_{(AMA\_DAGL)}$) ;
- levels of usage awareness, technology and innovation ($\bar{x}pct7_{(AMA\_DAGL)}$) ;
- Levels of technological sustainability, innovation and participatory management of the market garden value chain ($\bar{x}pct8_{(AMA\_DAGL)}$).

Based on a questionnaire survey designed to obtain results on sustainability scores and their rates, the research opted for a quantitative analysis. Questionnaires were administered to vegetable growers, traders and processors in both cities. The Global Positioning System (GPS) was also deployed to capture and geographically represent the various survey sites. The snowball technique was also used to reach respondents, particularly market gardeners who could not be found at market garden sites at any time of day.

Sampling

The research target population in Accra and Greater Lomé included vegetable producers, traders and processors aged 18 and over, who had been residing in these cities for at least one year prior to data collection.

Over 50% of respondents had at least five years' experience in their respective activities. But those with less than a year's experience are estimated at around 3%. In addition, respondents are interviewed according to whether or not they are self-employed or employ people to assist them in their respective activities, in order to increase the chances of obtaining information corresponding to the research objectives.

Producers are the men or women in the target population who, through urban agriculture, produce edible vegetables for sale to a customer.

Traders are the men or women in the target population, wholesalers, semi-wholesalers or retailers, who buy and resell the vegetables produced by market gardeners.

Processors are the men or women in the target population who, either manually or using technology, turn market garden vegetables into dishes for sale to the final consumer, either in raw form (vegetable salads) or as sauces.

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Purposive sampling has been adopted, inspired by V.S. Kwol and al. (2020, p. 2-3) and E. Babbie (2008, p. 203). E.R. Babbie (2016, p. 187) argues that it is sometimes preferable for the researcher, in relation to his aims, to selected the statistical units of his sample on the basis of knowing the target population and its components. Three hundred and three (303) stakeholders in the market-garden sectors of the two towns were interviewed: ninety-four (94) producers, one hundred and nineteen (119) traders and ninety (90) processors. In Accra, one hundred and fifty-six (156) were interviewed: 50 market gardeners, sixty-three (63) vegetable traders and forty-three (43) processors. In the Togolese capital, data collection involved one hundred and forty-seven (147) people: forty-four (44) growers, fifty-six (56) vegetable traders and forty-seven (47) processors. The choice of respondents was based on the consideration that the population follows a normal distribution implying a confidence level of 95% and an accuracy level of 5%. Based on these considerations, and according to L. Kish (1965), if the distribution of attributes lies between 20% and 80%, a sample of thirty (30) to two hundred (200) items is valid. This sample is made up of subgroups as presented above in terms of numbers. The size of these subgroups is defined in line with the findings of S. Sudman (1976) and D.I. Glenn (1992) concerning the comparative analysis of subgroups: in the case of comparison, 20 to 50 observations per subgroup are sufficient to extend the results to the total population.

Data Collection

The Kobokollect v2023.2.4 application was used to collect data using tablets. The data collection process was preceded by an exploratory phase, during which the status of the sites, people, activities and objects targeted by the research were ascertained. This was followed by a pre-survey to familiarize enumerators with the questionnaires. The principles of consent, confidentiality and the right to stop answering questions at any time were respected during data collection. The administration of each questionnaire took between twenty (20) and (30) minutes.

The table below shows the different sites involved in data collection, by city and by stakeholder category.

Table 1: Data collection sites in AMA and DAGL

Categories of actors	Data collection sites	
	AMA	**DAGL**
Producers	Djorwulu , Kawukudi , Korle Bu, Plant Pool, Roman Ridge	Lomé Ablogamé beach - beach; Kangnikopé , Baguida and in the port area.
Traders	Agbogbloshie market , Makola market , Kaneshie market , Nima market	the Hanoukopé market , the Abattoir market, the Atikpodzi market , the " Dekawowosime " market, the Akodessewa market , the " Gbossimé " market, the large Klikamé market, the Totsi market , the Bè market , the Amoutivé market , the Kégué market , the Hedzranawoé market , the " Assiyéyé " market of Agoè , the Totsi market , the Kélégougan market and the markets of Vakpossito , Legbassito , Sogbossito and Sagbado .
Transformers	Lapaz , Kaneshie Bus stop, Tema station, East Legon	

Sources: K. E. Assinou and K. Kpotchou 2024

Based on the FAO definition of vegetables (F. Beed and al., 2021, p. 2; FAO, 2021, p. 5), the types of this food category included in the analysis are: fruiting vegetables (tomatoes, peppers, etc.), leafy vegetables (spinach, broad beans, etc.), bulb vegetables (onions, spring onions, etc.), root vegetables (carrots, beet), stem vegetables (celery, kohlrabi, etc.), flowering vegetables and budding vegetables (cauliflower, broccoli, etc.). Vegetables excluded from the analysis are starchy plants (manioc, yams, etc.), legumes (beans, soya, etc.) and cereals (rice, corn, etc.).

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Data Processing and Analysis

The collected data were imported from Kobotoolbox and processed in Microsoft Office Excel 2019 spreadsheet software for the three respondent categories of AMA and DAGL. GPS data were processed with Google Earth Pro version 7.3.6.9345 to create landmarks corresponding to the research sites, for each respondent category. The landmarks created were then exported to arcGIS Destop 10.8.2 to obtain point layers and place them on maps of the administrative contours of Ghana, the Greater Accra region and the Accra metropolis.

Excel spreadsheets were used to calculate the data. Regarding the questions corresponding to the targeted indicators, following the example of M.N. Islam and al. (2023) and N.A. Moreb and al. (2017), each correct knowledge, attitude or practice selected by a respondent is scored at one (1) point. But the score is zero (0) for incorrect knowledge, attitudes and practices. The correct response percentages were calculated for all variable modalities, with questions being essentially multiple choices. Acceptable sustainability score means at least 50% correct answers. The answers are good if their rate is greater than or equal to seventy (70) percent. Sustainability is fairly good if the rate is between fifty-one (50) and sixty-nine (69) percent; it is low if the correct response rates are below fifty (50) percent.(

Regardless of knowledge, attitudes and practices, the arithmetic averages of the percentages of correct answer scores related to different aspects of sustainability (Socio-economic, Health of Actors, Food Protection and Conservation, Environmental Pollution, Waste and Losses, Technologies and Innovations, Governance) were calculated for each variable from the values of the variable modalities, for each category of actors and for all actors according to the following formulas:

General Formula 1

$$Rates\ (T) = \frac{Correct\ answer\ scores * 100}{\text{Sample size} * \text{number of correct answers}}$$

General Formula 2

$$\bar{x} = \sum \frac{x}{n} = \bar{x}pct\ (\text{AMA\_DAGL}) = \bar{x}\text{pct (AMA\_DAGL)} = \frac{\bar{x}\text{p(AMA DAGL)} + \bar{x}\text{c(AMA DAGL)} + \bar{x}\text{t(AMA DAGL)}}{3}$$

Other Formulas

- $\bar{x}_{pct\ (AMA\_DAGL)} = \bar{x}_{pct1(AMA\_DAGL)} + \bar{x}_{pct2(AMA\_DAGL)} + \bar{x}_{pct3(AMA\_DAGL)} + \bar{x}_{pct4(AMA\_DAGL)} + \bar{x}_{pct5(AMA\_DAGL)} + \bar{x}_{pct6(AMA\_DAGL)} + \bar{x}_{pct7(AMA\_DAGL)} + \bar{x}_{pct8(AMA\_DAGL)} / 8$
- $\bar{x}_{pct1(AMA\_DAGL)} = \bar{x}_{p1(AMA\_DAGL)} + \bar{x}_{c1(AMA\_DAGL)} + \bar{x}_{t1(AMA\_DAGL)} / 3$
- $\bar{x}_{pct2(AMA\_DAGL)} = \bar{x}_{p2(AMA\_DAGL)} + \bar{x}_{c2(AMA\_DAGL)} + \bar{x}_{t2(AMA\_DAGL)} / 3$
- $\bar{x}_{pct3(AMA\_DAGL)} = \bar{x}_{p3(AMA\_DAGL)} + \bar{x}_{c3(AMA\_DAGL)} + \bar{x}_{t3(AMA\_DAGL)} / 3$
- $\bar{x}_{pct4(AMA\_DAGL)} = \bar{x}_{p4(AMA\_DAGL)} + \bar{x}_{c4(AMA\_DAGL)} + \bar{x}_{t4(AMA\_DAGL)} / 3$
- $\bar{x}_{pct5(AMA\_DAGL)} = \bar{x}_{p5(AMA\_DAGL)} + \bar{x}_{c5(AMA\_DAGL)} + \bar{x}_{t5(AMA\_DAGL)} / 3$

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- $\bar{x}_{pct6(AMA\_DAGL)} = \bar{x}_{p6(AMA\_DAGL)} + \bar{x}_{c6(AMA\_DAGL)} + \bar{x}_{t6(AMA\_DAGL)} / 3$
- $\bar{x}_{pct7(AMA\_DAGL)} = \bar{x}_{p7(AMA\_DAGL)} + \bar{x}_{c7(AMA\_DAGL)} + \bar{x}_{t7(AMA\_DAGL)} / 3$
- $\bar{x}_{pct8(AMA\_DAGL)} = \bar{x}_{p8(AMA\_DAGL)} + \bar{x}_{c8(AMA\_DAGL)} + \bar{x}_{t8(AMA\_DAGL)} / 3$
- $\bar{x}_{p(AMA\_DAGL)} = \bar{x}_{p1(AMA\_DAGL)} + \bar{x}_{p2(AMA\_DAGL)} + \bar{x}_{p3(AMA\_DAGL)} + \bar{x}_{p4(AMA\_DAGL)} + \bar{x}_{p5(AMA\_DAGL)} + \bar{x}_{p6(AMA\_DAGL)} + \bar{x}_{p7(AMA\_DAGL)} + \bar{x}_{p8(AMA\_DAGL)} / 8$
- $\bar{x}_{c(AMA\_DAGL)} = \bar{x}_{c1(AMA\_DAGL)} + \bar{x}_{c2(AMA\_DAGL)} + \bar{x}_{c3(AMA\_DAGL)} + \bar{x}_{c4(AMA\_DAGL)} + \bar{x}_{c5(AMA\_DAGL)} + \bar{x}_{c6(AMA\_DAGL)} + \bar{x}_{c7(AMA\_DAGL)} + \bar{x}_{c8(AMA\_DAGL)} /8$
- $\bar{x}_{t(AMA\_DAGL)} = \bar{x}_{t1(AMA\_DAGL)} + \bar{x}_{t2(AMA\_DAGL)} + \bar{x}_{t3(AMA\_DAGL)} + \bar{x}_{t4(AMA\_DAGL)} + \bar{x}_{t5(AMA\_DAGL)} + \bar{x}_{t6(AMA\_DAGL)} + \bar{x}_{t7(AMA\_DAGL)} + \bar{x}_{t8(AMA\_DAGL)} / 8$

$\bar{x}p1_{(AMA\_DAGL)}$, $\bar{x}p2_{(AMA\_DAGL)}$, $\bar{x}p3_{(AMA\_DAGL)}$, $\bar{x}p4_{(AMA\_DAGL)}$, $\bar{x}p5_{(AMA\_DAGL)}$, $\bar{x}p6_{(AMA\_DAGL)}$, $\bar{x}p7_{(AMA\_DAGL)}$, $\bar{x}p8_{(AMA\_DAGL)}$, $\bar{x}c1_{(AMA\_DAGL)}$, $\bar{x}c2_{(AMA\_DAGL)}$, $\bar{x}c3_{(AMA\_DAGL)}$, $\bar{x}c4_{(AMA\_DAGL)}$, $\bar{x}c5_{(AMA\_DAGL)}$, $\bar{x}c6_{(AMA\_DAGL)}$, $\bar{x}c7_{(AMA\_DAGL)}$, $\bar{x}c8_{(AMA\_DAGL)}$, $\bar{x}t1_{(AMA\_DAGL)}$, $\bar{x}t2_{(AMA\_DAGL)}$, $\bar{x}t3_{(AMA\_DAGL)}$, $\bar{x}t4_{(AMA\_DAGL)}$, $\bar{x}t5_{(AMA\_DAGL)}$, $\bar{x}t6_{(AMA\_DAGL)}$, $\bar{x}t7_{(AMA\_DAGL)}$ and $\bar{x}t8_{(AMA\_DAGL)}$ are also calculated using the same formula : $\bar{x}=\sum x / n$.

$\bar{\mathbf{x}}$ or $\bar{\mathbf{x}}_{\mathbf{pct}(AMA\_DAGL)}$ is the overall average of the proportions of sustainable knowledge, attitudes and practices of producers, traders and processors in the Accra vegetable supply chain from socio-economic, environmental, health, technological and governance perspectives;

$\sum x$ represents the sum of the different values whose average is calculated;

n is the number of values whose average is calculated;

$\bar{\mathbf{x}}_{\mathbf{p}(AMA\_DAGL)}$, $\bar{\mathbf{x}}_{\mathbf{c}(AMA\_DAGL)}$ and $\bar{\mathbf{x}}_{\mathbf{t}(AMA\_DAGL)}$ are the averages of the proportions of socioeconomic, environmental, health, technological and participatory governance knowledge, attitudes and practices (KAP) considered respectively for market gardeners, traders and vegetable processors;

$\bar{x}_{p1(AMA\_DAGL)}$, $\bar{x}_{p2(AMA\_DAGL)}$, $\bar{x}_{p3(AMA\_DAGL)}$, $\bar{x}_{p4(AMA\_DAGL)}$, $\bar{x}_{p5(AMA\_DAGL)}$, $\bar{x}_{p6(AMA\_DAGL)}$, $\bar{x}_{p7(AMA\_DAGL)}$, $\bar{x}_{p8(AMA\_DAGL)}$, $\bar{x}_{c1(AMA\_DAGL)}$, $\bar{x}_{c2(AMA\_DAGL)}$, $\bar{x}_{c3(AMA\_DAGL)}$, $\bar{x}_{c4(AMA\_DAGL)}$, $\bar{x}_{c5(AMA\_DAGL)}$, $\bar{x}_{c6(AMA\_DAGL)}$, $\bar{x}_{c7(AMA\_DAGL)}$, $\bar{x}_{c8(AMA\_DAGL)}$, $\bar{x}_{t1(AMA\_DAGL)}$, $\bar{x}_{t2(AMA\_DAGL)}$, $\bar{x}_{t3(AMA\_DAGL)}$, $\bar{x}_{t4(AMA\_DAGL)}$, $\bar{x}_{t5(AMA\_DAGL)}$, $\bar{x}_{t6(AMA\_DAGL)}$, $\bar{x}_{t7(AMA\_DAGL)}$ and $\bar{x}_{t8(AMA\_DAGL)}$ are obtained from the average percentages of the sustainability rates calculated for the eight sustainability indicators taken into account for the research according to each category of actors. In doing so, "p", "c" and "t" represent respectively the producers, traders and processors of vegetables in the market gardening sectors of Accra and Greater Lomé;

$\bar{x}_{pct1(AMA\_DAGL)}$, $\bar{x}_{pct2(AMA\_DAGL)}$, $\bar{x}_{pct3(AMA\_DAGL)}$, $\bar{x}_{pct4(AMA\_DAGL)}$, $\bar{x}_{pct5(AMA\_DAGL)}$, $\bar{x}_{pct6(AMA\_DAGL)}$, $\bar{x}_{pct7(AMA\_DAGL)}$, $\bar{x}_{pct8(AMA\_DAGL)}$ are the overall averages of the sustainability rates calculated from the knowledge, attitudes and practices of producers, traders and processors of market garden vegetables according to the following eight (8) aspects of sustainability: degree of awareness of the sustainability of the activity, socio-economics, health of the actors, protection and conservation of food, losses and waste, environmental pollution and waste management , technologies and innovations, eco-nutritional education.

$\bar{\mathbf{x}}_{\mathbf{p1}(AMA\_DAGL)}$, $\bar{\mathbf{x}}_{\mathbf{c1}(AMA\_DAGL)}$ and $\bar{\mathbf{x}}_{\mathbf{t1}(AMA\_DAGL)}$ are the respective average rates of knowledge of producers, traders and processors regarding the sustainability criteria that their activities directly or indirectly influence;

$\bar{\mathbf{x}}_{\mathbf{p2}(AMA\_DAGL)}$, $\bar{\mathbf{x}}_{\mathbf{c2}(AMA\_DAGL)}$ and $\bar{\mathbf{x}}_{\mathbf{t2}(AMA\_DAGL)}$ represent respectively the average proportions of socioeconomic sustainability of market gardening activity, trade and vegetable processing;

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$\bar{x}_{p3(AMA\_DAGL)}$, $\bar{x}_{c3(AMA\_DAGL)}$ and $\bar{x}_{t3(AMA\_DAGL)}$, respectively indicate the average percentages of knowledge and practices of producers, traders and processors on the health risks inherent to their activities;

$\bar{x}_{p4(AMA\_DAGL)}$, $\bar{x}_{c4(AMA\_DAGL)}$ and $\bar{x}_{t4(AMA\_DAGL)}$ are the average rates of knowledge, attitudes and practices of producers, traders and processors on the protection and conservation of their products;

$\bar{x}_{p5(AMA\_DAGL)}$, $\bar{x}_{c5(AMA\_DAGL)}$ and $\bar{x}_{t5(AMA\_DAGL)}$, are the average levels of sustainability linked, respectively, to the rates of good practices of producers, traders and processors concerning losses and waste;

$\bar{x}_{p6(AMA\_DAGL)}$, $\bar{x}_{c6(AMA\_DAGL)}$ and $\bar{x}_{t6(AMA\_DAGL)}$ are the average proportions of sustainability linked respectively to the knowledge of producers, traders and processors regarding environmental pollution and waste management;

$\bar{x}_{p7(AMA\_DAGL)}$, $\bar{x}_{c7(AMA\_DAGL)}$ and $\bar{x}_{t7(AMA\_DAGL)}$ are the variables that, respectively, indicate the average adoption rates of innovative and technological practices of producers, traders and processors;

$\bar{x}_{p8(AMA\_DAGL)}$, $\bar{x}_{c8(AMA\_DAGL)}$ and $\bar{x}_{t8(AMA\_DAGL)}$ represent the average sustainability rates calculated respectively for the inclusive and participatory governance of the activities of producers, traders and processors in the vegetable supply chain of Accra.

The research results were compared with the socio-economic, health and ecological reality based on the principles of nutritional ecology, theme no. 13 of the "Global Reporting Initiative" standard, the Codex Alimentarius and the Sustainable Development Goals of the United Nations 2030 Agenda.

Results

Socio-Demographic Profiles of The Target Population

In the following table (No. 2), the respondents are distributed according to gender, age, length of experience in their respective activities, level of education and membership in one or more organizations relevant to their sector of activity.

Table 2: Socio-Demographic Distribution of Respondents from Accra and Greater Lomé

Sub-variables of the socio-demographic distribution of interviewees		Categories of actors						All the actors	
		Producers		Traders		Street food vendors			
		Effective	Frequency (%)	Effective	Frequency (%)	Effective	Frequency (%)	Effective	Frequency (%)
Accra Metropolitan Assembly									
Distribution of respondents according to gender	**Male**	50	100.0	5	7.9	6	14.0	**61**	**39.10**
	Female	0	0.0	58	92.1	37	86.0	**95**	**60.90**
Totals		**50**	**100.0**	**63**	**100.0**	**43**	**100.0**	**156**	**100.00**
Distribution of respondents	**18-35**	19	38.0	13	20.6	21	48.8	**53**	**33.97**
	36-45	14	28.0	24	38.1	12	27.9	**50**	**32.05**

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according to age	**46 years and over**	17	34.0	26	41.3	10	23.3	**53**	**33.97**
Totals		**50**	**100.0**	**63**	**100.0**	**43**	**100.0**	**156**	**100.00**
Distribution of respondents according to their length of experience in market gardening	**1 to 2 years**	6	12.0	7	11.1	12	27.9	25	**16.03**
	3 to 4 years	12	24.0	19	30.2	13	30.2	44	**28.21**
	5 years and over	31	62.7	37	58.7	18	41.9	87	**55.34**
Totals		**50**	**100.0**	**63**	**100.0**	**43**	**100**	**156**	**100.00**
Distribution of respondents according to their educational levels	**Uneducated**	13	26.7	19	30.2	3	7.0	**35**	**22.65**
	Primary	15	29.3	22	34.9	6	14.0	**43**	**27.35**
	Secondary	18	36.0	20	31.7	28	65.1	**66**	**42.31**
	Superior	4	8.0	2	3.2	6	14.0	**12**	**7.69**
Totals		**50**	**100.0**	**63**	**100.0**	**43**	**100.0**	**156**	**100.00**
Distribution of interviewees according to their membership in farmer/trader/processor organizations	**1**	33	66.7	19	30.2	8	18.6	**60**	**38.68**
	2 or more	0	0.0	7	11.1	1	2.3	**8**	**5.13**
	None	17	33.3	37	58.7	34	79.1	**88**	**56.20**
Totals		**50**	**100.0**	**63**	**100.0**	**43**	**100.0**	**156**	**100.00**

Greater Lomé

Distribution of respondents according to gender	**Female**	15	34.8	51	91.1	40	85.1	106.3	72.3
	Male	29	65.2	5	8.9	7	14.9	40.7	27.7
Totals		**44**	**100.0**	**56**	**100.0**	**47**	**100.0**	**147.0**	**100.0**
Distribution of respondents according to age	**18-35**	15	34.1	24	42.9	23	48.9	62.0	42.2
	36-45	12	27.3	17	30.4	15	31.9	44.0	29.9
	46 years and over	17	38.6	15	26.8	9	19.1	41.0	27.9

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Totals		**44**	**100.0**	**56**	**100.0**	**47**	**100.0**	**147.0**	**100.0**
Distribution of respondents according to their length of experience in market gardening	**1 to 2 years**	4	9.1	11	19.6	15	31.9	30.0	20.4
	3 to 4 years	4	9.1	13	23.2	14	29.8	31.0	21.1
	5 years and over	35	79.5	32	57.1	18	38.3	85.0	57.8
Totals		**44**	**100.0**	**56**	**100.0**	**47**	**100.0**	**147.0**	**100.0**
Distribution of respondents according to their educational levels	**Uneducated**	13	30.3	15	26.8	8	17.0	36.3	24.7
	Primary	7	15.2	17	30.4	7	14.9	30.7	20.9
	Secondary	21	47.7	18	32.1	28	59.6	67.0	45.6
	Superior	3	6.8	6	10.7	4	8.5	13.0	8.8
Totals		**44**	**100.0**	**56**	**100.0**	**47**	**100.0**	**147.0**	**100.0**
Distribution of interviewees according to their membership in farmer/trader/processor organizations	**1**	11	25.8	12	21.4	2	4.3	25.0	17.0
	2 or more	2	4.5	3	5.4	3	6.4	8.0	5.4
	None	31	69.7	41	73.2	42	89.4	114.0	77.6
Totals		**44**	**100.0**	**56**	**100.0**	**47**	**100.0**	**147.0**	**100.0**

Sources: K. E. Assinou and K. Kpotchou 2024

In the population targeted by the research, men make up 100% of the producers sample compared to 65% in the main city of Togo. However, in terms of the market garden vegetable trade, women are more numerous: they make up 92.1% of the sample in Accra and 91.1% of that in the Autonomous District of Greater Lomé (DAGL). The same is true for the gender distribution of the actors who work to serve dishes produced partly or entirely from vegetables. In doing so, 86% of the caterers interviewed in Accra are women compared to 85% in Greater Lomé. It is therefore observed that women dominate the market gardening sectors in Accra and Greater Lomé. This excess of the female workforce by the number of men in the two sectors is generally noticeable in Accra at a rate of 60.90% against 72.3% in Greater Lomé. From these results, we can deduce that the market gardening sectors of Accra and Greater Lomé are characterized by a gender-based distribution of tasks between men and women, the former taking care of production and the latter having a "monopoly" on the first place in the marketing of harvested products as well as in their processing and resale as dishes in restaurants.

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Regarding the age of the actors, respondents aged between 18 and 45 constitute between 65.4% (AMA) and 72% (DAGL) of the sample on both sides of the two cities, the rest (34.6%) being 46 years and older. It is irrefutable evidence that the market gardening sectors of Accra and Greater Lomé have a significant "workforce" due to their average composition of 68.7% of young people belonging to the aforementioned age category. This trend is also highlighted at the level of each category of actors in both the market gardening sector of Accra and that of Greater Lomé. Thus, in the Ghanaian capital, young people aged 18 to 45 constitute respectively 66%, 58.7% and 76.7% of the workforce of producers, traders and vegetable processors. In the same order of classification of entities, for the same age category of Greater Lomé, 61.4% of producers, 73.3% of traders and 80.8% of caterers make up the market gardening supply chain of the DAGL. This can constitute a significant socio-economic added value to the sector in terms of increasing the quantity of production, productivity and profitability. Given the accelerated population growth experienced by these cities and the resulting demand for vegetables, this can result in a significant improvement in the living conditions of the actors in this sector who will be able to meet their most basic needs provided that their means of subsistence (technical, logistical and financial investment capacities) are strengthened.

In addition, between 55.34% (Accra) and 57.8% (Greater Lomé) of the actors surveyed have, at least, 5 years of experience in their respective activities. With the exception of processors who, in both cities, have less than 5 years of experience for the most part (41.9% for AMA against 38.3% for DAGL), the majority of producers (62.7% in Accra and 79.5% in Greater Lomé) and traders (58.7% in Accra and 57.1% in Greater Lomé) in both cities have been working in these market gardening supply chains for more than five years.

As for the level of education, the interviewees who were not literate only make up 22.65% of the AMA sample and 24.7% of the DAGL sample. This tendency towards the general education rate is tangible at the level of each actor in the market gardening sectors of the two urban centers: uneducated producers (26.7% in AMA and 30.3% in DAGL); uneducated traders (30.2% at AMA and 26.8% at DAGL); restorers (7% at AMA and 17% in DAGL). It can be deduced that approximately 70% of producers, traders and processors in the market gardening sectors of Accra and Greater Lomé have the facilitation of the assimilation of socio-technical training courses that can be organized for them. Their levels of experience can also be a driver of success for learning new production and investment techniques.

But the opposite situation occurs when it comes to the propensity of respondents to belong to corporate organizations. Indeed, in Accra (56.20%) and Greater Lomé (77.6%), on average, 67% of actors do not belong to any corporate organization that could potentially facilitate their integration, professionalization and broader openness to the business world. This clearly constitutes a barrier to inclusion and socio-economic integration for most of these actors who risk being under-informed about developments inherent in their respective sectors of activity in terms of new knowledge, techniques, innovations, etc. This lack of inclusiveness or solidarity of market gardening sector actors in the two cities can negatively affect its assets so that the potential benefit that can be derived from it is not realized. The fact that the majority of actors are between 18 and 45 years old (more than 60%), have more than 5 years of professional experience (more than 55%) and are more than 70% educated does not constitute a significant socio-economic, health and ecological sustainability advantage as proven by the results data in table no. 3 presented below.

Uncertain socio-economic, health and ecological sustainability around the knowledge, attitudes and practices of actors in the market gardening sectors of Accra and Greater Lomé

Table 3 : Quantified Overview of Outcomes Related to Levels of Knowledge, Good Practices and Attitudes of Different Actors in Relation to The Sustainability Dimensions Considered

Indicators	**Producers (x̄p)**	**Traders (x̄c)**	**processors (x̄t)**	**All stakeholders (x̄pct)**

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$\bar{x}pct1_{(AMA\_DAGL)}= \bar{x}p1_{(AMA\_DAGL)} + \bar{x}c1_{(AMA\_DAGL)}+\bar{x}t1_{(AMA\_DAGL)} / 3$	$\bar{x}p1_{(DAGL)}$	$\bar{x}p1_{(AMA)}$	$\bar{x}c1_{(DAGL)}$	$\bar{x}c1_{(AMA)}$	$\bar{x}t1_{(DAGL)}$	$\bar{x}t1_{(AMA)}$	$\bar{x}pct1_{(DAGL)}$	$\bar{x}pct1_{(AMA)}$
	22,7	44,0	24,3	22,3	15,6	30,5	21,0	31,5
	$\bar{x}p1_{(AMA\_DAGL)}$	33,4	$\bar{x}c1_{(AMA\_DAGL)}$	23,3	$\bar{x}t1_{(AMA\_DAGL)}$	23,0	$\bar{x}pct1_{(AMA\_DAGL)}$	26,3
$\bar{x}pct2_{(AMA\_DAGL)}= \bar{x}p2_{(AMA\_DAGL)} + \bar{x}c2_{(AMA\_DAGL)}+\bar{x}t2_{(AMA\_DAGL)} / 3$	$\bar{x}p1_{(DAGL)}$	$\bar{x}p1_{(AMA)}$	$\bar{x}c1_{(DAGL)}$	$\bar{x}c1_{(AMA)}$	$\bar{x}t1_{(DAGL)}$	$\bar{x}t1_{(AMA)}$	$\bar{x}pct1_{(DAGL)}$	$\bar{x}pct1_{(AMA)}$
	54,6	38,9	40,8	36,4	33,1	33,2	42,5	36,2
	$\bar{x}p2_{(AMA\_DAGL)}$	46,7	$\bar{x}c2_{(AMA\_DAGL)}$	38,6	$\bar{x}t2_{(AMA\_DAGL)}$	33,2	$\bar{x}pct2_{(AMA\_DAGL)}$	39,3
$\bar{x}pct3_{(AMA\_DAGL)}= \bar{x}p3_{(AMA\_DAGL)} + \bar{x}c3_{(AMA\_DAGL)}+\bar{x}t3_{(AMA\_DAGL)} / 3$	$\bar{x}p1_{(DAGL)}$	$\bar{x}p1_{(AMA)}$	$\bar{x}c1_{(DAGL)}$	$\bar{x}c1_{(AMA)}$	$\bar{x}t1_{(DAGL)}$	$\bar{x}t1_{(AMA)}$	$\bar{x}pct1_{(DAGL)}$	$\bar{x}pct1_{(AMA)}$
	35,4	20,6	25,7	17,1	38,3	20,2	33,7	20,2
	$\bar{x}p3_{(AMA\_DAGL)}$	28,0	$\bar{x}c3_{(AMA\_DAGL)}$	21,4	$\bar{x}t3_{(AMA\_DAGL)}$	29,2	$\bar{x}pct3_{(AMA\_DAGL)}$	26,9
$\bar{x}pct4_{(AMA\_DAGL)}= \bar{x}p4_{(AMA\_DAGL)} + \bar{x}c4_{(AMA\_DAGL)}+\bar{x}t4_{(AMA\_DAGL)} / 3$	$\bar{x}p1_{(DAGL)}$	$\bar{x}p1_{(AMA)}$	$\bar{x}c1_{(DAGL)}$	$\bar{x}c1_{(AMA)}$	$\bar{x}t1_{(DAGL)}$	$\bar{x}t1_{(AMA)}$	$\bar{x}pct1_{(DAGL)}$	$\bar{x}pct1_{(AMA)}$
	23,6	11,5	43,2	17,9	43,3	4,9	41,8	20,9
	$\bar{x}p4_{(AMA\_DAGL)}$	17,5	$\bar{x}c4_{(AMA\_DAGL)}$	30,6	$\bar{x}t4_{(AMA\_DAGL)}$	24,1	$\bar{x}pct4_{(AMA\_DAGL)}$	31,4
$\bar{x}pct5_{(AMA\_DAGL)}= \bar{x}p5_{(AMA\_DAGL)} + \bar{x}c5_{(AMA\_DAGL)}+\bar{x}t5_{(AMA\_DAGL)} / 3$	$\bar{x}p1_{(DAGL)}$	$\bar{x}p1_{(AMA)}$	$\bar{x}c1_{(DAGL)}$	$\bar{x}c1_{(AMA)}$	$\bar{x}t1_{(DAGL)}$	$\bar{x}t1_{(AMA)}$	$\bar{x}pct1_{(DAGL)}$	$\bar{x}pct1_{(AMA)}$
	16,5	21,0	56,3	47,5	65,6	56,6	40,4	44,4
	$\bar{x}p5_{(AMA\_DAGL)}$	18,7	$\bar{x}c5_{(AMA\_DAGL)}$	51,9	$\bar{x}t5_{(AMA\_DAGL)}$	61,1	$\bar{x}pct5_{(AMA\_DAGL)}$	42,4
$\bar{x}pct6_{(AMA\_DAGL)}= \bar{x}p6_{(AMA\_DAGL)} + \bar{x}c6_{(AMA\_DAGL)}+\bar{x}t6_{(AMA\_DAGL)} / 3$	$\bar{x}p1_{(DAGL)}$	$\bar{x}p1_{(AMA)}$	$\bar{x}c1_{(DAGL)}$	$\bar{x}c1_{(AMA)}$	$\bar{x}t1_{(DAGL)}$	$\bar{x}t1_{(AMA)}$	$\bar{x}pct1_{(DAGL)}$	$\bar{x}pct1_{(AMA)}$
	24,1	29,2	21,9	20,3	26,1	18,3	26,1	28,2
	$\bar{x}p6_{(AMA\_DAGL)}$	26,6	$\bar{x}c6_{(AMA\_DAGL)}$	21,1	$\bar{x}t6_{(AMA\_DAGL)}$	22,2	$\bar{x}pct6_{(AMA\_DAGL)}$	27,2
$\bar{x}pct7_{(AMA\_DAGL)}= \bar{x}p7_{(AMA\_DAGL)} + \bar{x}c7_{(AMA\_DAGL)}+\bar{x}t7_{(AMA\_DAGL)} / 3$	$\bar{x}p7_{(DAGL)}$	$\bar{x}p7_{(AMA)}$	$\bar{x}c7_{(DAGL)}$	$\bar{x}c7_{(AMA)}$	$\bar{x}t7_{(DAGL)}$	$\bar{x}t7_{(AMA)}$	$\bar{x}pct7_{(DAGL)}$	$\bar{x}pct7_{(AMA)}$
	15,7	8,4	11,8	5,9	26,3	28,6	22,9	14,3
	$\bar{x}p7_{(AMA\_DAGL)}$	12,1	$\bar{x}c7_{(AMA\_DAGL)}$	8,8	$\bar{x}t7_{(AMA\_DAGL)}$	27,5	$\bar{x}pct7_{(AMA\_DAGL)}$	18,6
$\bar{x}pct8_{(AMA\_DAGL)}= \bar{x}p8_{(AMA\_DAGL)} + \bar{x}c8_{(AMA\_DAGL)}+\bar{x}t8_{(AMA\_DAGL)} / 3$	$\bar{x}p8_{(DAGL)}$	$\bar{x}p8_{(AMA)}$	$\bar{x}c8_{(DAGL)}$	$\bar{x}c8_{(AMA)}$	$\bar{x}t8_{(DAGL)}$	$\bar{x}t8_{(AMA)}$	$\bar{x}pct8_{(DAGL)}$	$\bar{x}pct8_{(AMA)}$
	11,2	26,5	5,8	16,7	26,6	15,1	14,1	19,4
	$\bar{x}p8_{(AMA\_DAGL)}$	18,8	$\bar{x}c8_{(AMA\_DAGL)}$	11,2	$\bar{x}t8_{(AMA\_DAGL)}$	20,9	$\bar{x}pct8_{(AMA\_DAGL)}$	16,7
$\bar{x}pct_{(AMA\_DAGL)}= \bar{x}p_{(AMA\_DAGL)} + \bar{x}c_{(AMA\_DAGL)}+\bar{x}t_{(AMA\_DAGL)} / 3$	$\bar{x}p_{(DAGL)}$	$\bar{x}p_{(AMA)}$	$\bar{x}c_{(DAGL)}$	$\bar{x}c_{(AMA)}$	$\bar{x}t_{(DAGL)}$	$\bar{x}t_{(AMA)}$	$\bar{x}pct_{(DAGL)}$	$\bar{x}pct_{(AMA)}$
	25,5	25,0	28,7	23,0	34,4	25,9	30,3	26,9
	$(\bar{x}p1_{(AMA\_DAGL)} +\bar{x}p2_{(AMA\_DAGL}$	25,2	$(\bar{x}c1_{(AMA\_DAGL)} +\bar{x}c2_{(AMA\_DAGL}$	25,9	$(\bar{x}t1_{(AMA\_DAGL)} +\bar{x}t2_{(AMA\_DAGL)}$	30,1	$\bar{x}pct_{(AMA\_DAGL)}$	28,6

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	$)+\bar{xp}3_{(A}$ MA_DAGL $)+\bar{xp}4_{(A}$ MA_DAGL $)+\bar{xp}5_{(A}$ MA_DAGL $)+\bar{xp}6_{(A}$ MA_DAGL $)+\bar{xp}7_{(A}$ MA_DAGL $)+\bar{xp}8_{(A}$ MA_DAGL $))$ /8		$)+\bar{xc}3_{(A}$ MA_DAGL $)+\bar{xc}4_{(A}$ MA_DAGL $)+\bar{xc}5_{(A}$ MA_DAGL $)+\bar{xc}6_{(A}$ MA_DAGL $)+\bar{xc}7_{(A}$ MA_DAGL $)+\bar{xc}8_{(A}$ MA_DAGL $))$ /8		$+\bar{xt}3_{(AM}$ A_DAGL) $+\bar{xt}4_{(AM}$ A_DAGL) $+\bar{xt}5_{(AM}$ A_DAGL) $+\bar{xt}6_{(AM}$ A_DAGL) $+\bar{xt}7_{(AM}$ A_DAGL) $+\bar{xt}8_{(AM}$ A_DAGL)) /8			

Sources : K. E. Assinou and K. Kpotchou 2024

The reading of table 3 shows that, in general, the levels of knowledge of the three categories of actors (vegetable producers, vegetable traders and processors) are low with regard to the harmful effects of their respective activities on their socio-economic and health well-being and on the preservation of nature's constituents. For this indicator, the overall rate calculated, although below 50%, is higher in the Ghanaian capital (31.5%) than in that of Togo (21%). In each of the two agglomerations, this trend was observed as much among producers (44% against 22.7%) as among processors (30.5% against 15.6%) notwithstanding the fact that the opposite was the case for processors (22.3% against 24.3%). On average, this indicator ($\bar{xp}ct1_{(AMA\_DAGL)}$) has a value of 26.3%. But it is higher at the level of producers ($\bar{xp}1_{(AMA\_DAGL)}$=33,4%) than at the level of traders ($\bar{xc}1_{(AMA\_DAGL)}$=23,3%) and processors ($\bar{xt}1_{(AMA\_DAGL)}$=23%) of the two cities.

This result can have negative influences on the development of a good awareness of social responsibility among all the actors in their working relationships with their employees.

The graph below (n°1) illustrates this

Low Awareness of Social Responsibility in The Vegetable Supply Chains of Accra and Greater Lomé

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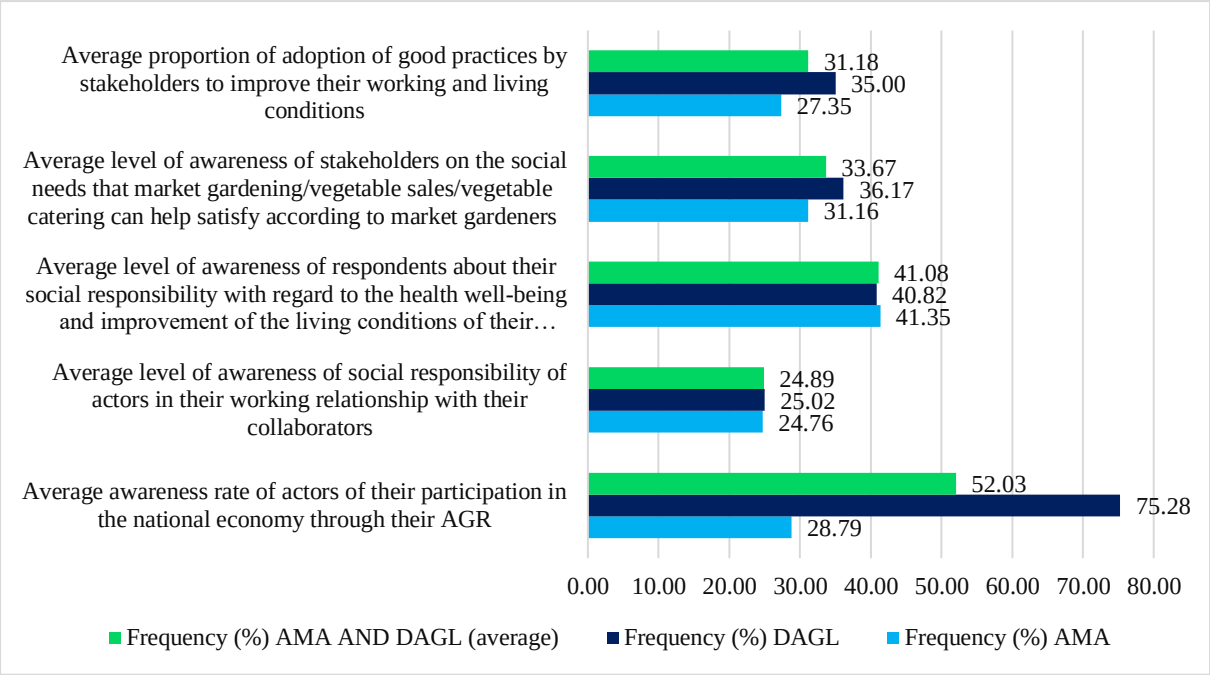
Figure 1: Levels of Awareness of Social Responsibility in the Relationships between Actors and Their Employees



Sources: K. E. Assinou and K. Kpotchou 2024

In Accra's vegetable sector, the majority (58.65%) of respondents do not believe they are responsible for the health well-being and improved living and working conditions of their employees; the same is true for 59.18% of all actors in Greater Lomé (see graph n°1°). In Table n°3, this low level of social responsibility is assessed at 46.7% ($\bar{xp}2_{(AMA\_DAGL)}$) in production, 38.6% ($\bar{xc}2_{(AMA\_DAGL)}$) in marketing and 33.2% ($\bar{xt}2_{(AMA\_DAGL)}$) in vegetable processing, giving an average of 39.3% ($\bar{xpct}2_{(AMA\_DAGL)}$). This attitude can be a source of inadequate treatment for the workers of these market gardeners, and reinforce the existing socio-economic gaps between them when it comes to the possibility of some or others being able to afford decent housing, food, drinking water, healthcare and clothing. This can even undermine their social acceptance and recognition if social integration factors do not allow them to do so.

The low level of social responsibility may also be accompanied by a lack of awareness among the people surveyed of the risks of food contamination and poisoning of the end consumer, as shown in graph 2.

Insufficient knowledge among producers, traders and processors of the health risks associated with their practices

In the market garden sectors of Accra and Greater Lomé, the general rate of knowledge and modes of use not harmful to food and to the physical, mental, reproductive and intellectual well-being of the operators averaged 26,9% ($\bar{xpct}3_{(AMA\_DAGL)}$). Traders adopting the recommended practices in the market garden supply chains of Ghana's capital and Togo's are identified at a rate of 21.4% ($\bar{xc}3_{(AMA\_DAGL)}$), while processors are identified at 29,2% ($\bar{xt}3_{(AMA\_DAGL)}$) and producers at 28% ($\bar{xp}3_{(AMA\_DAGL)}$). There are several reasons for these low rates (graph no. 2): the low level of good practice in cleaning, washing and disinfecting tools used for growing, exposing, cooking and serving food (48.30%); respondents' insufficient knowledge of the illnesses that can be caused to humans by eating food containing traces of pesticides (13.22%); respondents' ignorance of the deleterious effects of the vegetable growing or processing water they use (4.36%). The same applies to the low tendency of all stakeholders to take measures for self-protection and treatment of foodstuffs before handling (20.15%), and their propensity to treat waste water used for cultivation (7.86%).

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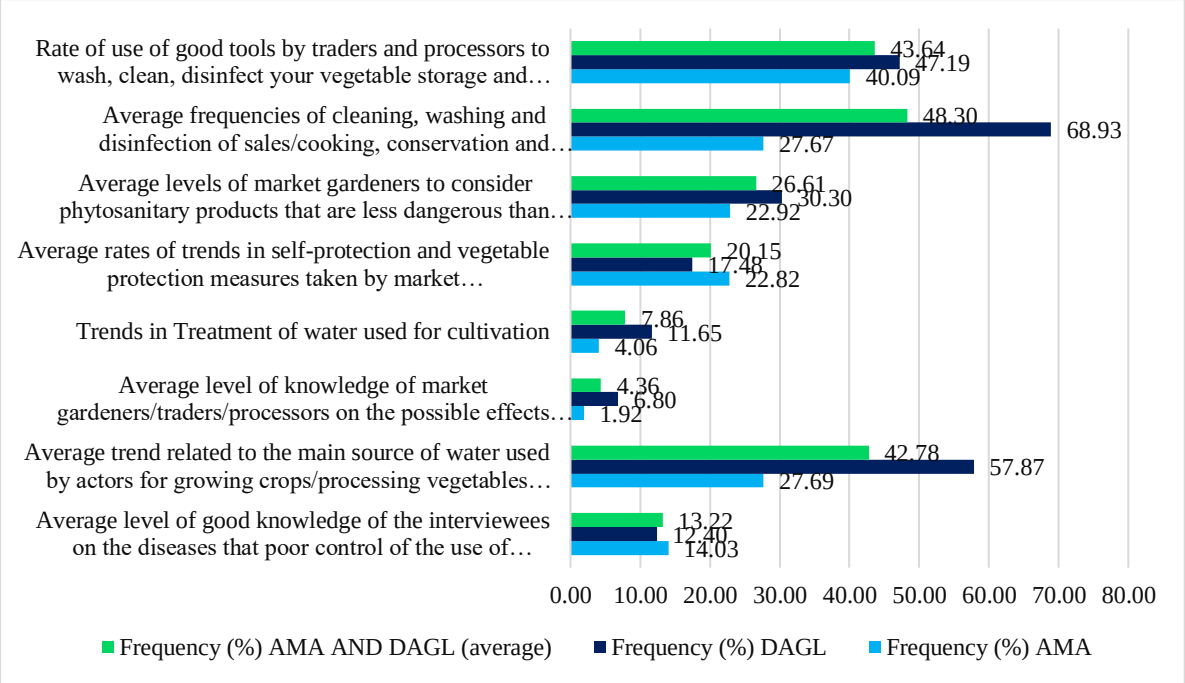
Figure 2: Trends in Stakeholders' Knowledge and Best Practices Regarding Health Risks in The Market Gardening Sector



Sources: K. E. Assinou and K. Kpotchou 2024

These figures illustrate the considerable health risks faced by suppliers and their customers when it comes to contaminating food with toxins and poisoning consumers. Ignorance or indifference on the part of stakeholders to the risks associated with the consumption of food containing traces of pesticides can, in the long term, expose consumers to carcinogenic pathologies, allergies, gastritis, and so on. The untreated use of water for growing and cooking food represents a major risk of contamination by pathogenic microbes, viruses and parasites.

These human health risks are prolonged by handling operations that expose vegetables to all kinds of contamination. Diagram 3 provides further details.

Improper protection and preservation of market garden vegetables at AMA and DAGL

This third figure illustrates the fact that the majority of market gardeners (89.8%) interviewed were under-informed about the possible effects of the irrigation water they use on the quality of the food they produce. In fact, only 3.54% of Accra's supply chain actors are aware of the potential risk to food quality from the use of unclean irrigation water, compared with 10.22% in Greater Lomé. This is reflected in the degree of ignorance of most market gardeners in the two towns regarding the effects of fertilizer and pesticide abuse on health (24.06%). Even good vegetable preservation techniques are used by only a minority of respondents (29.66%). In Table 3, this indicator stands at 31.4% ($\bar{x}pct4_{(AMA\_DAGL)}$) among all the respondents interviewed. But good techniques for preserving and protecting these foods are used more by vegetable traders ($\bar{x}c4_{(AMA\_DAGL)}$=30,6%) than by processors ($\bar{x}t4_{(AMA\_DAGL)}$=24,1%) and producers ($\bar{x}p4_{(AMA\_DAGL)}$=17,5%).

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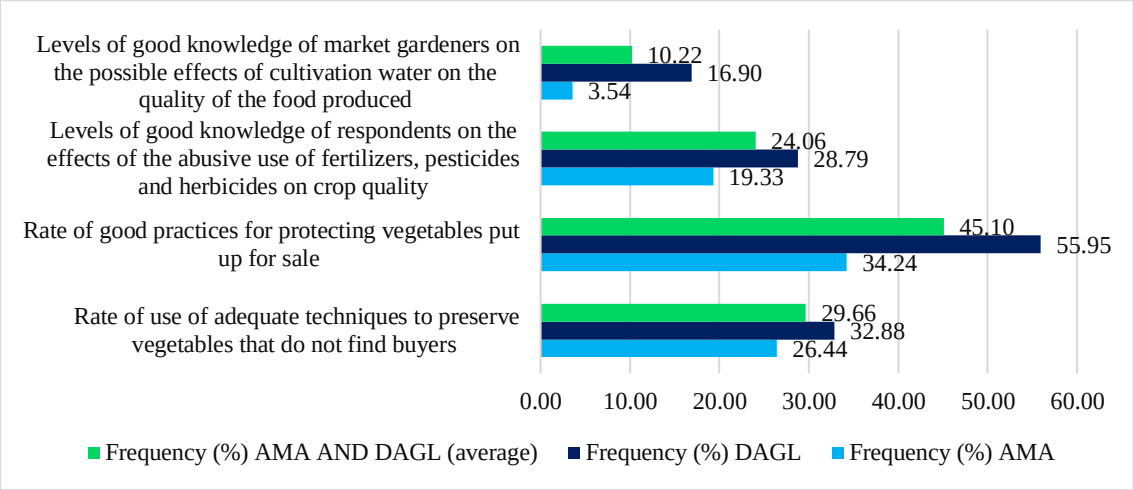
Figure 3: Food Protection and Preservation at The Production, Processing and Marketing Stages



Sources: K. E. Assinou and K. Kpotchou 2024

These results confirm the exposure of vegetables to chemical, parasitic, viral and microbial contaminants in the supply chains in question. They also call into question the socio-technical capacity of the vegetable supply chain in both Lomé and Accra, where the key operators lack the knowledge and even the tools to enable them to keep their produce for an extended, but reasonable, period without losing essential nutrients. This socio-technical shortcoming is inevitably a source of nutritional degradation of foodstuffs, and of financial and economic losses for all stakeholders. Moreover, this cannot fail to affect their standard of living through reduced purchasing power and, by extension, their ability to meet their basic needs.

As a result, market gardeners in Accra and Greater Lomé are likely to lose significant quantities of their produce, either through rotting, decay or mildew, and even more so through lack of the necessary processing skills should decomposition prove unavoidable. Graphs 4 and 5, shown below, provide details.

Inappropriate management of decomposing vegetables and the waste that emanates from them in the Accra and Greater Lomé vegetable chains

In both AMA and DAGL, stakeholders have almost zero socio-technical mastery of the management of vegetables in the early stages of molding and putrefaction. The observed rate of good practices associated with handling these vegetables is 6.52% on average, 10% in Ghana's first city and 3,03% in Togo's first urban agglomeration. Putrefied, rotted or moldy vegetables are handled better there, but the level of good practices associated with this handling is still low (30.78%); 32% in AMA and 29.55% in DAGL (see graph n°4). Although the management of leftover food served by caterers is more viable due to the adoption of good management practices for such food by a significant proportion of caterers (50.69%), the issue of losses remains important due to the fact that the management of moldy, decayed or rotten vegetables is not sustainable at the production and marketing stages. In contrast to Greater Lomé, where 90.22% of food service operators mismanage excess prepared dishes, in Accra it's a minority (8.51%) who mismanage excess prepared or served dishes. Table 3 shows that only 42.4% ($\bar{x}pct5_{(AMA\_DAGL)}$) of respondents adopt sustainable vegetable handling practices. But these good practices are more observed among women restorers ($\bar{x}t5_{(AMA\_DAGL)}$=61,1%) and vegetable traders ($\bar{x}c5_{(AMA\_DAGL)}$=51,9%). This rate is very low in the production link ($\bar{x}p5_{(AMA\_DAGL)}$=18,7%) where there is a higher risk of food loss (graph n°4).

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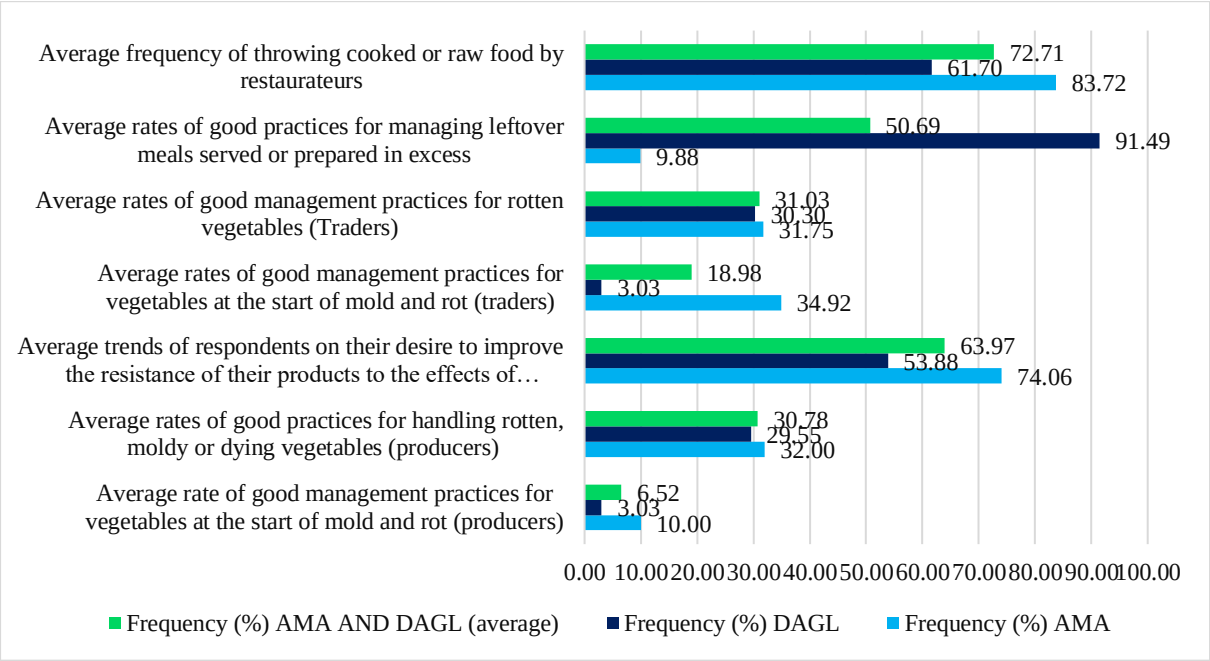
Figure 4: Risk Of Loss And Waste



Sources: K. E. Assinou and K. Kpotchou 2024

If vegetable preservation and the management of decomposing vegetables are defective in the Accra and Greater Lomé vegetable sectors, and give rise to high loss probabilities, doubts remain as to the propensity of AMA and DAGL vegetable producers, traders and processors to exploit their waste in a sustainable manner (Figure 5).

Ecological insensitivity in the management of food waste from vegetable supply chains in Accra and Greater Lomé

The data in the fifth diagram confirm that 57.29% of market gardeners in Accra and Greater Lomé are not sufficiently aware of the hazardous effects of excessive fertilizer and pesticide use on soil biochemistry and fertility. The majority (65.12%) are unaware that intensive weeding and ploughing can destroy soil fertility in the long or medium term. Similarly, only 22.65% are conscious that their vegetable production, marketing and processing activities are sources of air pollution and degradation of terrestrial and aquatic ecosystems. However, 75.78% of those interviewed who work in vegetable production are not thinking of using less polluting plant protection products that are at the same time more profitable. What's more, organic waste from these activities is more likely to be thrown away than processed. Indeed, only 13.45% of the sample had ever thought of turning rotten or moldy vegetables into fertilizer or making them useful. The situation is no different when it comes to the proper management of inorganic waste in this sector. For both cities, the average level of good treatment of these wastes is calculated at 25.22%.

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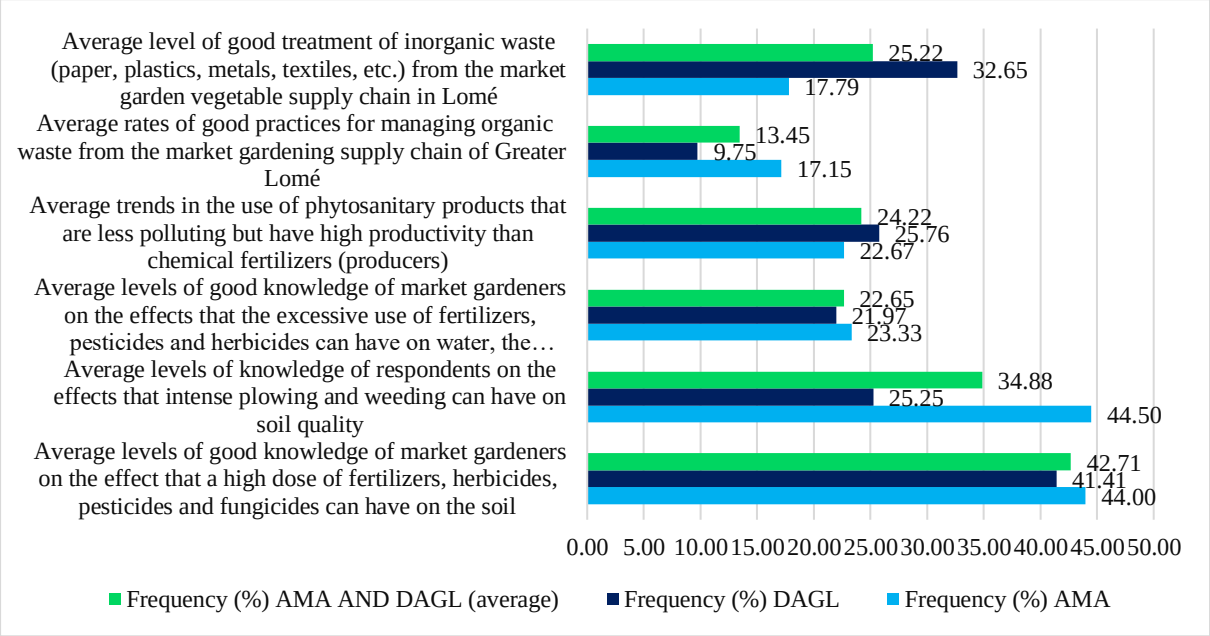
Figure 5: Rates of Environmental Pollution and Good Waste Management Practices



Sources: K. E. Assinou and K. Kpotchou 2024

In table n°3, for all actors, the rates of good waste management practices and ecological awareness are at 27.2% ($\bar{x}pct6_{(AMA\_DAGL)}$). This ecological awareness in relation to good waste management practices is slightly higher among producers (26,6%= $\bar{x}p6_{(AMA\_DAGL)}$) than among traders (21,1%= $\bar{x}c6_{(AMA\_DAGL)}$) and processors (22,2% $\bar{x}t6_{(AMA\_DAGL)}$). From these results, we can see that the sectors targeted by the research are subject to significant pollution and degradation threats to cultivated soils, surface and groundwater, and ambient air, without ignoring the imbalance this can create in the plant and animal life these ecosystems harbor. Due to the failure of the majority of stakeholders to adopt good waste management practices, the market garden sectors in the first towns of Ghana and Togo are not spared the possibility of spreading certain viral, microbial or parasitic diseases via vector agents. Nevertheless, this reduces the socio-economic development potential of these sectors, as mentioned above.

These generally negative results for the two sectors in terms of socio-economic, health and environmental sustainability linked to the knowledge, attitudes and practices of the actors are corroborated by their low technical-innovative awareness and their predominant tendency to be under-informed (graphs n°6 and n°7).

Unawareness of technical innovation and low levels of eco-nutritional and health education among stakeholders

Figure 6 shows that in both Accra and Greater Lomé, the proportion of vegetable producers, traders and processors who have digitized their activities is limited to an average of between 5.46% and 19.79%. Likewise, the average level of use of digital applications by all these operators in their respective Income-Generating Activities (IGA) is virtually null (1.11%). This remains true for the level of use of social networks (on average 24.45%) in vegetable production, sales or processing activities in the main urban centers of

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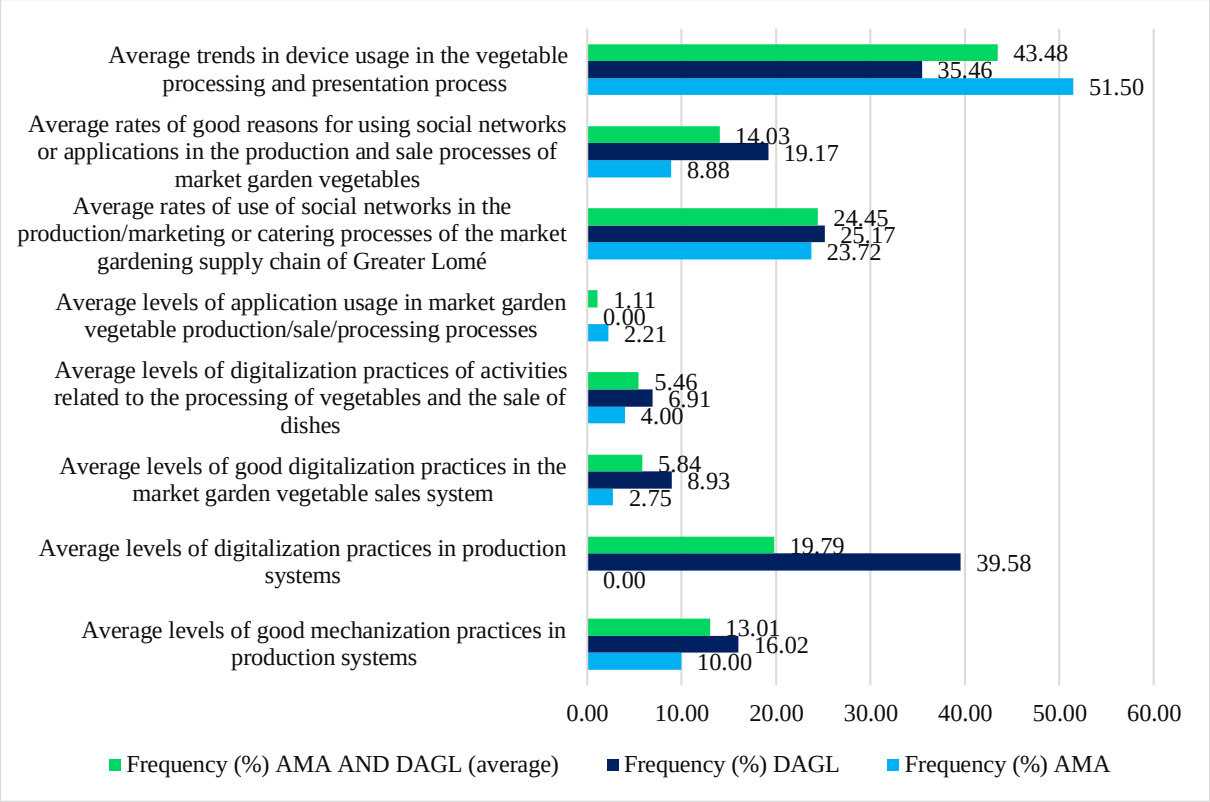
Ghana and Togo. Even the rate of mechanization of cultivation activities at grower level is only 13.01% on average. While in Accra, the rate of equipment use in food processing is not low (51.50%), in Greater Lomé it is around 35.46%.

Figure 6: Rate of Use of Technological or Innovative Tools



Sources: K. E. Assinou and K. Kpotchou 2024

The average market gardener in Accra and Greater Lomé has a very low tendency to associate their IGAs with the use of applications, social networks and even mechanization (18,6%= $\bar{x}pct7_{(AMA\_DAGL)}$). Admittedly, this trend is generally observed, but catering operators (27,5%= $\bar{x}t7_{(AMA\_DAGL)}$) adopt technological communication tools as well as those for digitizing their activities more than producers (12,1%= $\bar{x}p7_{(AMA\_DAGL)}$) and merchants (8,8%= $\bar{x}p7_{(AMA\_DAGL)}$). This data highlights the isolation of Accra and Greater Lomé's market garden sector participants from the rest of the world. Virtually absent from social networks and digital platforms, and under-tooled in the digitization of their activities, they run the risk of stagnating competitively and not being encouraged to be more creative. This would reduce their capacity to mobilize economic partnerships, expand their customer portfolios and increase their sales. Under these conditions, the IGAs of market garden supply chain actors in the capital cities of Ghana and Togo are faced with income shortfalls, which, to some extent, may reduce their ability to provide adequately for themselves and their families. At the same time, their contributions to the national economy will remain limited.

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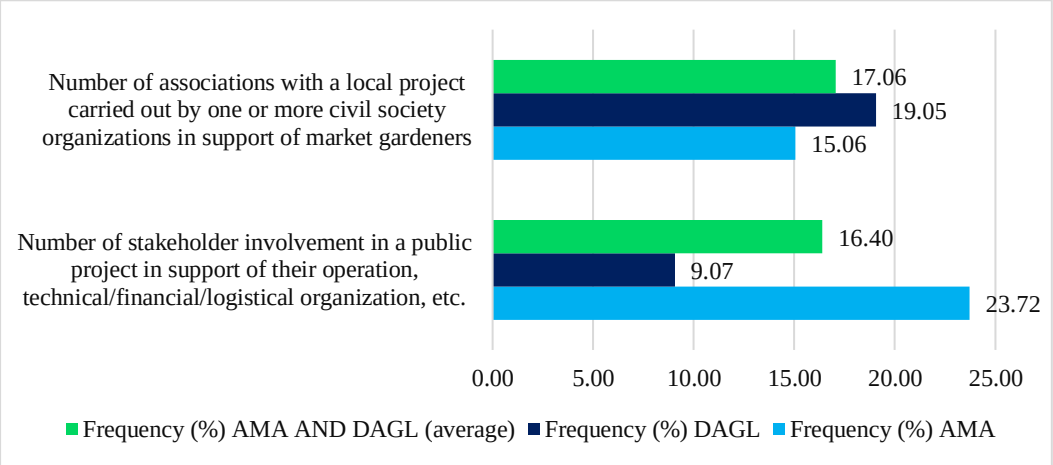
This analysis of the results is borne out by the low level of participation of stakeholders (16.40% to 17.06%) in public projects or projects run by NGOs and associations related to the ecological and nutritional education needed to make this food system sustainable (Figure 7).

Figure 7: Rate of Food and Nutrition Education Benefits



Sources: K. E. Assinou and K. Kpotchou 2024

Lastly, Table n°3 confirms that the actors who have at least once benefited from projects to educate people about an ecological and nutritional food supply make up only 16.7% of the sample ($\bar{x}pct8_{(AMA\_DAGL)}$). But processors (20,9%=$\bar{x}t8_{(AMA\_DAGL)}$) benefited more than producers (18,8%=$\bar{x}p8_{(AMA\_DAGL)}$) and traders (11,2%=$\bar{x}t8_{(AMA\_DAGL)}$).

Discussion

In view of the research findings, the socio-economic, health (food and nutrition) and environmental sustainability of Accra and Greater Lomé's vegetable supply has a low sustainability potential ($\bar{x}pct_{(AMA\_DAGL)}$=30,35%), based on the recommendations of Global Reporting Initiative 2023 Standard 13 relating to the agriculture, aquaculture and fisheries sector. The same is true for the Sustainable Development Goals (SDGs) of the United Nations Agenda 2030 in consideration of the principles of the nutrition ecology theory defined above (GSSB, 2023; C. Leitzmann, 2003; K. Schneider and I. Hoffmann, 2011; UN, 2017). This discussion includes some Codex Alimentarius standards as tools:

- "General principles of food hygiene" (CXC 1-1969)
- "Code of hygienic practice for fresh fruits and vegetables" (CXC 53-2003);
- “Code of practice for packaging and transport of fresh fruit and vegetables” (CXC 44-1995).

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The "Codex Alimentarius" comprises standards, guidelines and codes of practice drawn up jointly by the Codex Alimentarius Commission of the FAO and WHO, then adopted internationally to ensure the safety, quality and ethical distribution of foodstuffs worldwide.

The discussion revolves the outcomes related to the key indicators considered.

In Table 3, the data show that 73.7% (26,3%=$\bar{x}pct1_{(AMA\_DAGL)}$) of the stakeholders surveyed are unaware of the direct or indirect effects of their vegetable production, trading or processing activities on the preservation of natural resources, food and nutritional security, biodiversity, their own income and, by extension, their ability to meet their most basic needs. Given this degree of unawareness of the potential effects of their uses on the socio-economic, health and environmental well-being of the first towns of Ghana, Togo and even other West African countries, we can deduce that their practices are out of step with GRI 13 and CXC 53-13 of the Codex Alimentarius. This may constitute a lasting bottleneck for data improvement in relation to the indicators of SDGs 1, 2, 3, 11, 12, 13, 14, 15, 16 and even 17.

The same applies to the second indicator ($\bar{x}pct2_{(AMA\_DAGL)}$) in relation to stakeholders' levels of awareness of their social responsibility in their relations with their employees. The value of this indicator (39.3%) points to the difficult socio-economic inclusion faced by actors in the AMA and DAGL vegetable chains, contrary to the assertion of R. Vos and A. Cattaneo (2021). This level of socio-economic responsibility is an inevitable source of inequality and social injustice, which can fuel frustration within society, leading to conflict to a lesser extent, and worse, vulnerability to radicalization by extremist groups. This reduces the target population's chances of achieving SDG 8, 10 or even 16 by 2030. This outcome is therefore not conducive to sustained economic growth, full and productive employment, decent work for all and lasting societal peace in West African cities.

The lagging awareness of vegetable producers, sellers and processors in Accra and Greater Lomé ($\bar{x}pct2_{(AMA\_DAGL)}$=26,9%) regarding the health risks associated with their activities makes consumers and vegetable growers themselves vulnerable to cancerous, nervous, cardiovascular and even genital pathologies. This has been demonstrated in existing literature by A. Ahamad and J. Kumar (2023); I. Baldi and al. (2021); P. Biswas and al. (2023); R. Calderon and al. (2022); K. Farswan (2021); A. Inobeme and al. (2020); M. Khan and al. (2023); W. Lai (2017); B. Le Huy and al. (2022); A.K. Mohiuddin (2019). As regards good practices for cleaning, washing and disinfecting tools for storing, displaying, cooking or presenting vegetables, the percentage calculated is 26.9% ($\bar{x}pct3_{(AMA\_DAGL)}$). Adequate vegetable protection and preservation practices at the production, marketing and processing stages are also a low percentage ($\bar{x}pct4_{(AMA\_DAGL)}$= 31,4%**)**. This implies either a lack of knowledge or negligence on the part of the market garden stakeholders assessed with regard to the risks of biochemical, bacterial, viral or parasitic poisoning entailed by their practices for both themselves and their customers (G.N. Murthy and P.B.S. Yadav, 2024; G.A. Santarelli and al., 2018). These results do not meet Codex Alimentarius codes of practice, standards and guidelines for hygienic practice in the handling of fresh vegetables, nor are they beneficial to the achievement of SDG3. The handling of vegetables in the value chains assessed therefore does not guarantee a safe food environment, nor does it truly protect against occupational health insecurity, as recommended by GRI Standard 13 themes 13.9, 13.10 and 13.19, Codex Alimentarius CXC 1-1969 and CXC 53-2003 (G.I. Balali and al., 2020; J. Waage and al., 2022).

Loss risks are also high in the vegetable supply chains of Accra and Greater Lomé, but are not perceived as much by producers, traders and processors themselves, with the associated awareness rate at 42.4% ($\bar{x}pct5_{(AMA\_DAGL)}$). These shortcomings inherent in the food systems whose sustainability is being assessed are also obstacles to the achievement of SDGs 8, 11, 12 and even 13). C. Chauhan and al. (2021), M. Kummu and al. (2012), S.D. Porter and al. (2016), M. Sheahan and C.B. Barrett (2017), E. Surucu-Balci and O. Tuna (2021) et S.M. Wunderlich and N.M. Martinez (2018) have focused on these issues in their work on loss and waste in food systems.

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But the poor control of the conservation and protection of vegetables increasing the risks of losses also has harmful ecological implications of which only 27.2% of the stakeholders are aware ($\bar{x}pct6_{(AMA\_DAGL)}$). This rate obtained from the levels of good practices in the use of pesticides and fertilizers, waste management from the supply of vegetables and soil treatment is a warning sign of environmental degradation, progressive reduction and "de-fertilization" of the cultivable space in urban areas. We deduce the fact that the natural environment is subject to air and water pollution, soil degradation and the reduction of biodiversity in the vegetable supply chain in Accra and Greater Lomé. Uncertainty thus looms with regard to the achievement of SDGs 6, 14 and 15 which, respectively, advocate sustainable consumption of water resources as well as the preservation of aquatic and terrestrial ecosystems (I. Ansari and al., 2021; S. Nayak and al., 2020; P. Rajak and al., 2023; A.L. Srivastav, 2020; S. Tripathi and al., 2020; M. Tudi and al., 2021; V.L. Zikankuba and al., 2019). These results contrast with several themes (13.1; 13.3; 13.4; 13.5; 13.6; 13.7; 13.8) of GRI Standard 13 and CXC1-1969 of the Codex Alimentarius, concerning food hygiene, preservation of biodiversity, natural ecosystems, soil health, responsible use of pesticides, reasonable exploitation of water and sustainable waste management.

These ecological, health and socio-economic concerns emanating from the research results are aggravated by the low levels (18,6%=$\bar{x}pct7_{(AMA\_DAGL)}$) at which all the actors in the market gardening sectors of Accra and Greater Lomé are investing in digitizing their Income-Generating Activities (IGAs) or making them more efficient or attractive through the use of applications, social networks or technological tools. This technological and innovative insensitivity observed in the supply of vegetables to the Ghanaian and Togolese capitals is the source of unproductivity, low profitability and the inability of all stakeholders to improve their working and living conditions. By thus marginalizing itself from the rest of the business world, this sector with classic socio-technical capacities is still far from achieving SDGs 9 and 8. The low participation rate of stakeholders in projects and programs (public or led by NGOs) intended to strengthen their socio-economic and professional inclusion, as well as their socio-technical capacities for access to financial and productive assets confirms previous trends (16,7%=$\bar{x}pct8_{(AMA\_DAGL)}$).

The preservation of socio-economic well-being, decent incomes and professional inclusion are therefore not guaranteed to producers, traders and processors of vegetables in the food systems assessed as provided for in themes 13.12, 13.21 and 13.22 of the GRI standard.

Conclusion

The eco-nutritional knowledge, attitudes and practices of producers, traders and processors in the market gardening sectors of Accra and Greater Lomé are assessed at an overall average rate of 28.6% ($\bar{x}pct_{AMA\_DAGL}$) with regard to the socio-economic, health, ecological, technological, innovative and "professional inclusiveness" dimensions of their activities taken together or individually. In both sectors, the sustainability gap to be filled is 71.4% (74.8% among producers, 74.1% among traders and 69.9% among processors, at a rate of 73.1% in Accra and 69.7% in Greater Lomé) of knowledge, good attitudes and practices to hope to achieve the sustainable development objectives in this sector by 2030. This raises a crucial problem oriented towards the establishment of an integrated, inclusive and permanent eco-nutritional education program concerning all stakeholders in the supply of vegetables to the AMA and the DAGL to make the efforts to make these food systems viable profitable.

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Authors' contributions

ASSINOU Kokou Elom: Project administration; Conceptualization; Methodology, Resources, software, investigation, Data curation, writing—original draft, analysis, validation. KPOTCHOU Koffi: Supervision, Conceptualization, Project administration, Resources, writing—review, validation.
All authors have read and agreed to publish this version of the manuscript.

Conflicts of Interest

The authors declare that there is no conflict of interest**.**

Institutional Review Board Statement

The study was conducted in accordance with the guidelines of the Declaration of Helsinki and the provisions of the Research and Innovation Charter of the University of Lomé of June 9, 2020.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study. The principles of anonymity, confidentiality and the liberty to refuse or stop an interview in progress were respected.

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